Pothole Classification Using CNNs

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Introduction

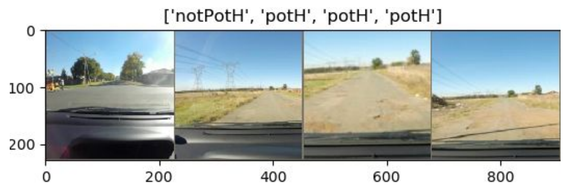
- Potholes can cause misalignment of the vehicles from intended path & damage vehicle structure which can lead to accidents.
- With employment of autonomous vehicles in passenger travel, the accurate detection is important for taking evasive measures.
- This study focuses on using convolutional neural networks to come up with a robust model to classify pothole images and suggest some unprecedented applications. The borrowed dataset used consists of images taken in South Africa.

Problem

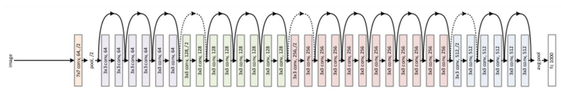
- Given an image of the road, identify if the image contains potholes or not.
- Compare the performance of ResNet18 and GoogLeNet on the given dataset

Dataset

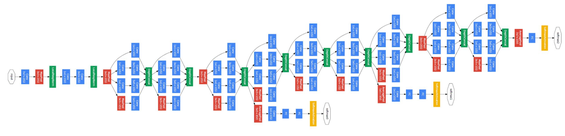
- Original Data
  - High resolution images of size 3680 x 2760
  - **1958** images **with** potholes
  - **9289** images **without** potholes
- Distribution
  - Test and Validation Set: 200 positive and 800 negative randomly picked images for each
  - Train Set: Remaining images.
- Data Augmentation
  - Resized to 400 x 300 to increase efficiency of computation pipeline
  - Random cropping on resized image, horizontal flipping, again resizing to reduce to network's input size.
  - Example show in figure below



Architecture



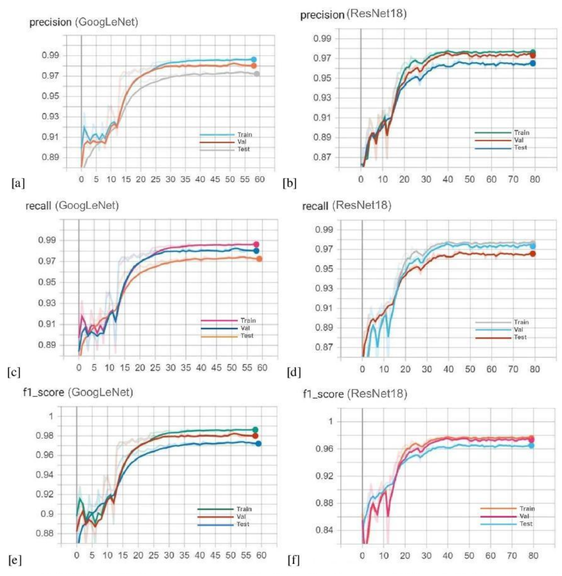
ResNet18 architecture



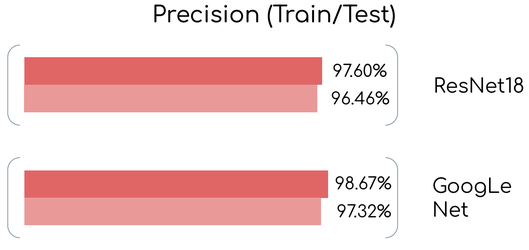
GoogLeNet architecture

- In both, ResNet18 and GoogLeNet, the no.of of neurons in the last layer have been changed from 1000 to 2 for binary classfication.
- The first and second neuron correspond to negative and positive classification respectively.

Results

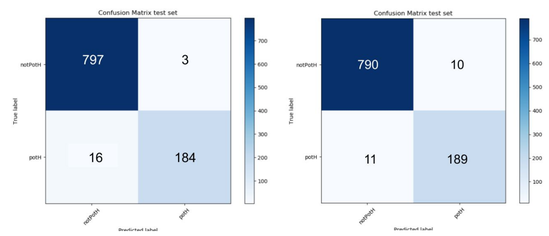


The above graphs have weighted metrics



Discussion

	Precision	Recall	F1 Score
ResNet18	0.9646	0.9657	0.9651
GoogLeNet	0.9732	0.9735	0.9734



- The weighted, to account for data-imbalance, cross entropy loss gave poorer performance, observed from the matrix on the right compared to the left.
- In all, GoogLeNet gave better results across all the metrics as shown in the table

Future Work

- Experimenting with more architectures, or even building one from scratch
- Collect more varied data which not so much co-related as this dataset

Notable References

For full list please checkout
https://github.com/adigera/Pothole-Classification-using-CNNs

1. MJ Booysen S. Nienaber and RS Kroon. "A Comparison of Low-Cost Monocular Vision Techniques for Pothole Distance Estimation". In: (Dec. 2015). DOI: 10.1109/SSCI.2015.69.
2. MJ Booysen S. Nienaber and RS Kroon. "DETECTING POTHOLES USING SIMPLE IMAGE PROCESSING TECHNIQUES AND REAL-WORLD FOOTAGE". In: South African Transport Conference